Alaska Department of Fish and Game
Division of Wildlife Conservation
December 1999

Furbearer Management Technique Development

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Research Performance Report
Federal Aid in Wildlife Restoration
1 July 1998–30 June 1999
Grant W-27-2, Study 7.18

This is a progress report on continuing research. Information may be refined at a later date.

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RESEARCH PROGRESS REPORT

STATE: Alaska **Study:** 7.18

COOPERATORS: Merav Ben-David and Pamela Groves, University of Alaska, Fairbanks; Brad Shults and Kyran Kunkel, National Park Service; Earl Becker, Ward Testa, and Becky Strauch, Alaska Department of Fish and Game, and Audrey Magoun

GRANT: W–27–2

STUDY TITLE: Furbearer Management Technique Development

JOB TITLES:

1. Distribution and trend of marten, lynx, and snowshoe hare populations
2. Densities, trend, and harvest potential of wolverine populations
3. Distribution, trend, habitat use, and Harvest Potential of Coastal River Otter Populations
4. Applying the Lynx Tracking Harvest Strategy Through Rule-Based Modeling

PERIOD: 1 July 1998 – 30 June 1999

SUMMARY

Each of the 4 jobs in this comprehensive study represents a separate research project to address the development of furbearer management techniques in Southcentral Alaska.

Job 1. During this reporting period, we revised our plan to establish a system of setting up aerial transects to count tracks in snow of lynx, marten, and snowshoe hares. We will use a gps-linked computer program to establish a set of systematically placed 3- to 5-km-long linear transects across a variety of terrain and vegetation types. Transect endpoints will be GPS coordinates that will allow aircraft pilots to follow the route more easily than flying between geographic features (Golden 1987, Golden 1988). We will attempt to complete the development and testing of the software during winter 1999–2000.

Job 2. We updated wolverine survival estimates for our radiocollared animals originally calculated through the Kaplan-Meier procedure modified for staggered entry of additional animals. We used a modification of this procedure that accounts for uncertain relocation of marked animals, i.e., when the probability of relocation is <1. We estimated the sustainable yield of female wolverines for an area the size of Game Management Unit 13A (11,500 km^2), using a model incorporating variation of the Leslie matrix models and modified for wolverines. Modified Kaplan-Meier survival rates (± SD) of all radiocollared wolverines in the Talkeetna Mountains averaged 0.83 ± 0.04 annually. Survival for females ($\bar{x}$ = 0.90 ± 0.14) was significantly higher than for males ($\bar{x}$ = 0.79 ± 0.20) (χ^2 = 7.423, df = 1, P < 0.01). Survival for wolverines first captured as adults (>2 years old) ($\bar{x}$ = 0.85 ± 0.20) was

significantly higher than for those first captured as yearlings (1–2 years old) ($\bar{x}$ = 0.81 ± 0.21) (χ^2 = 11.936, df = 1, P < 0.005). Survival of all radiocollared wolverines in the Driftwood area of the western Brooks Range averaged 0.87 ± 0.12 annually and was significantly higher than survival in the Talkeetna Mountains (χ^2 = 10.80, df = 1, P <0.005). The estimated sustainable yield of female wolverines for an 11,500-km^2 area was 4.91 (range = -0.76–18.12) for the Talkeetna Mountains and 5.68 (range = -2.36–20.88) for the Driftwood area, with lambda at 1.22 and 1.27 for the 2 areas, respectively. Assuming an even sex ratio, the total annual yield for a population of 54 wolverines should be 9.8 for the Talkeetna Mountains and 11.4 for the Driftwood area. Because these estimates are for harvested populations, they should be considered additional to the average harvest, which for GMU 13A was 4.9 wolverines for 1984–1998. We believe we met most of the assumptions of the Kaplan-Meier procedure specified by Pollock et al. (1989) and later modified by Bunck et al. (1995).

Job 3. We are collaborating with Drs. Pamela Groves and Merav Ben-David at the University of Alaska Fairbanks (UAF) to analyze river otter scat for DNA microsatellites. We sampled river otter scats among 62 latrine sites in Culross Passage, Eshamy Bay, and Herring Bay in Prince William Sound. We assessed the habitat of 32 latrine sites among Naked Island, Peak Island, Storey Island, and Culross Passage in Prince William Sound. The DNA analysis of the river otter scats from Kachemak Bay is underway; we expect it to be completed by April 2000. We will use the results to attempt to estimate river otter density and use of latrine sites by individual animals. Preliminary analysis of diet items in river otter scat collected in Kachemak Bay, Alaska in 1996 indicate river otters preferred larger fish (>15 cm) over smaller fish (<8 cm), based on the number of scats per latrine site in which fish were found and the minimal number of fish found per latrine site (Table 3.1). Probably because of the larger quantity of food in the larger fish, the minimum number of individual fish per scat was inversely related to the other 2 parameters. The most prevalent families of fish in scat for 8-cm fish were salmon, gunnel, flatfish, and stickleback; for 8–15-cm fish they were gunnel, codfish, sand lance, and sculpin; and for >8-cm fish the most prevalent were flatfish, sculpin, salmon, and greenling.

Job 4. I updated the user guide to installing and running the model LynxTrak and distributed a runtime version of the model to potential users on the web site of the Alaska Department of Fish and Game.

Key words: Density estimation, DNA microsatellite, expert system, food habits, *Gulo gulo*, habitat use, harvest, latrine site, *Lepus americanus*, line-intercept sampling, *Lutra canadensis*, lynx, *Lynx canadensis*, marten, *Martes americana*, movements, quadrat sampling, relative abundance, river otter, rule-based model, sample unit probability estimator, snowshoe hare, survival, sustainable yield, wolverine.

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STUDY BACKGROUND

This is the fourth progress report in a comprehensive program to develop furbearer management techniques by (1) evaluating the scope of species-specific management problems, (2) designing methods to address specific management needs, (3) testing the reliability and usefulness of those methods, (4) refining methods as needed, and (5) facilitating the implementation of suitable techniques. This research study currently encompasses 4 projects, or jobs, that represent furbearer management issues of concern in Southcentral Alaska. The goals of these 4 jobs are as follows:

1. Develop ground and aerial techniques for counting tracks in winter to monitor the distribution and trend of marten (*Martes americana*), lynx (*Lynx canadensis*), and snowshoe hare (*Lepus americanus*) populations in Southcentral Alaska.

2. Assess the accuracy of density estimation techniques and develop techniques to monitor the trend and harvest potential of wolverine (*Gulo gulo*) populations in Southcentral Alaska.

3. Develop techniques to index river otter (*Lutra canadensis*) populations, determine the availability and use of their habitat, and assess their harvest potential in coastal environments of Southcentral Alaska.

4. Develop a rule-based lynx management model to use in the lynx-tracking harvest strategy.

JOB 1 — DISTRIBUTION AND TREND OF MARTEN, LYNX, AND SNOWSHOE HARE POPULATIONS

During this reporting period, we revised our plan to establish a system of setting up aerial transects to count tracks in snow of lynx, marten, and snowshoe hares. We will use a gps-linked computer program to establish a set of systematically placed 3- to 5-km-long linear transects across a variety of terrain and vegetation types. Transect endpoints will be GPS coordinates that will allow aircraft pilots to follow the route more easily than flying between geographic features (Golden 1987, Golden 1988). We will attempt to complete the development and testing of the software during winter 1999–2000.

JOB 2 — DENSITIES, TREND, AND HARVEST POTENTIAL OF WOLVERINE POPULATIONS

Golden (1993), Golden et al. (1993*a*), and Golden (1996) provided background for this project. Work was planned for Jobs 2.1 and 2.2, but snow and weather conditions were unsuitable for conducting tests of the sample-unit probability estimator (SUPE) (Becker 1991, Golden 1997, Becker et al. 1998) or conducting population density estimates.

OBJECTIVES

2.1 To assess the accuracy and relative precision of wolverine density estimates derived from line-intercept and quadrat sampling techniques.

2.2 To estimate the densities and trends of wolverine populations in different areas of Southcentral Alaska.

2.3 To determine if relationships exist between trends in wolverine density and trends in wolverine harvest, food availability, and abundance of large predators.

2.4 To estimate sustainable harvest levels of wolverine populations in Southcentral Alaska.

STUDY AREAS

The primary area is the eastern Talkeetna Mountains, which lie between the Chugach Mountains and Alaska Range and form the western Nelchina River basin. A description of this area is presented in Golden (1996). Study areas in the Kenai Mountains and Wrangell Mountains are described in Golden et al. (1993a,b). The Driftwood study area in the western Brooks Range is described in Magoun (1985).

METHODS

Job 2.1. Tests of Wolverine Density-Estimation Techniques

We did not conduct tests of the density estimation technique this year due to unfavorable snow and weather conditions. Plans for modifying test procedures are described in the Discussion section.

Job 2.2. Wolverine Density and Trend Counts

We did not conduct density and trend counts this year because (1) they were of secondary priority to testing the density estimation technique and (2) snow and weather conditions were unfavorable in the primary count areas adjacent to the Talkeetna Mountains study area.

Job 2.3. Wolverine Harvest and Habitat Relationships

We did not conduct work on this job during the performance period.

Job 2.4. Wolverine Population Model

We updated wolverine survival estimates for our radiocollared animals originally calculated through the Kaplan-Meier procedure modified for staggered entry of additional animals (Pollock et al. 1989). We used a modification of this procedure that accounts for uncertain relocation of marked animals, i.e., when the probability of relocation is <1 (Bunck et al. 1995). This new procedure divides the study into periods, which in our case were based on 6 months. Only those animals at risk during a particular period were recorded as present. Entries for each marked animal were 1 for present, 0 for absent or not heard, or 9 if found dead. We then developed a matrix indicating presence or absence of each animal across all periods. We estimated survival (S) for each period as

$$\hat{S}_i = 1 - d_I / r_i,$$

where r_i is the number of animals at risk and d_i is the number of deaths in the *i*th interval. The cumulative survival function was estimated by the product of the survival estimates for each period,

$$\hat{S}(t) = \prod_{i \le t} \hat{S}_i ,$$

We estimated survival rates using 6-month-long periods beginning in April 1992 and extending for 6 years to March 1998. We also calculated mean annual survival for the entire population and for females, males, adults, and yearlings. A Chi-square test was used to measure differences between sex and age classes (Pollock et al. 1989).

Because we did not radiocollar kits in this study, we estimated survival from birth to age 1 by dividing the proportion of kits to adult females in the harvest for 1962–1968 by the average litter size (determined from embryos in carcasses) (Rausch and Pearson 1972). We used age ratios reported from this period because wolverine harvest was particularly intensive (due to bounties, aerial shooting, digging wolverines out of dens, and professional hunting and trapping) and, therefore, was probably more representative of actual age ratios in the population than more recent estimates that reflect traditional hunting and trapping practices (Figures 2.1 and 2.2).

We also compared mean annual survival rates for wolverines in the Talkeetna Mountains study area with that of the more lightly harvested Driftwood study area in the western Brooks Range for the period April 1978–September 1982 (Magoun 1985). A Chi-square test was used to measure differences between the 2 areas (Pollock et al. 1989).

We estimated the sustainable yield of female wolverines for an area the size of Game Management Unit (GMU) 13A (11,500 km^2), using a model incorporating variation of the Leslie matrix models described by Eberhardt and Siniff (1977) and modified for wolverines by W. Testa (personal communication). This model uses vital statistics of wolverines that were derived from survival estimates in the Talkeetna Mountains and the Driftwood area and from reproductive data on wolverines in Alaska and Yukon Territory (Rausch and Pearson 1972, Magoun 1985). Variables used in the model were (1) survival from birth to year 1, (2) annual yearling and adult survival, (3) average age of first parturition, (4) mean annual birth rate in female offspring per female, and (5) population size based on recent wolverine density estimates (Becker 1991, Becker and Gardner 1992, Golden et al. 1993*a*). The model estimated sustainable yield as equal to

$$n * (\lambda - 1) / \lambda,$$

where n is the estimated population size and λ (lambda) is the finite rate of population growth.

RESULTS

Job 2.4. Wolverine Population Model

Modified Kaplan-Meier survival rates (± SD) of all radiocollared wolverines in the Talkeetna Mountains averaged 0.83 ± 0.04 annually (Figure 2.3 and Table 2.1). Survival for females ($\bar{x}$ = 0.90 ± 0.14) was significantly higher than for males ($\bar{x}$ = 0.79 ± 0.20) (χ^2 = 7.423, df = 1, P < 0.01) (Figure 2.4). Survival for wolverines first captured as adults (>2 years old) ($\bar{x}$ = 0.85 ± 0.20) was significantly higher than for those first captured as yearlings (1–2 years old) ($\bar{x}$ = 0.81 ± 0.21) (χ^2 = 11.936, df = 1, P < 0.005) (Figure 2.4).

Survival of all radiocollared wolverines in the Driftwood area of the western Brooks Range averaged 0.87 ± 0.12 annually (Figure 2.5, Table 2.1) and was significantly higher than survival in the Talkeetna Mountains (χ^2 = 10.80, df = 1, P <0.005) (Figure 2.6).

The estimated sustainable yield of female wolverines for an 11,500-km^2 area was 4.91 (range = -0.76–18.12) for the Talkeetna Mountains and 5.68 (range = -2.36–20.88) for the Driftwood area (Table 2.2), with lambda at 1.22 and 1.27 for the 2 areas, respectively. Assuming an even sex ratio, the total annual yield for a population of 54 wolverines should be 9.8 for the Talkeetna Mountains and 11.4 for the Driftwood area. Because these estimates are for harvested populations, they should be considered additional to the average harvest, which for GMU 13A was 4.9 wolverines for 1984–1998.

DISCUSSION

Job 2.1. Tests of Wolverine Density-Estimation Techniques

The conditions required to test the accuracy of the sample unit probability estimator (SUPE) technique for wolverines (Becker et al. 1998) have not yet been met in the original Talkeetna Mountains study area. Consequently, we will attempt to estimate the density of wolverines in at least 1 of several test areas: 3 areas in the Nelchina Basin, 1 in the western Chugach Range near Anchorage, and 1 in the western Brooks Range. The latter area will be surveyed in cooperation with the National Park Service, which has begun a research project on wolverines. We will conduct the tests within 24 hours following a snowfall sufficient to cover all old tracks. We will survey the same sample units for 3–5 consecutive days to look for tracks of wolverines not detected during the SUPE on day 1. We will assess the techniques' accuracy by measuring the proportion of animals detected by the SUPE among the number counted (Golden 1997). SUPE maps were prepared for 3 areas in the Nelchina Basin and 1 area in the western Brooks Range.

Job 2.4. Wolverine Population Model

We believe we met most of the assumptions of the Kaplan-Meier procedure specified by Pollock et al. (1989) and later modified by Bunck et al. (1995). We were able to randomly sample animals of a particular sex and age class by capturing all but 2 animals through helicopter darting. We made no effort to select certain individuals, although we probably caught more males than females because males ranged more widely and may have been more vulnerable to our capture techniques. We met the assumption that survival times were independent for different animals because wolverines are generally solitary and young may be independent before the age of 1 year. Except for the study-related death of a subadult female, we believe it is unlikely that capturing the study animals or their wearing a radiocollar influenced their survival. We considered animals at risk only when they were relocated (even if dead) at some point during a 6-month period and censored them when we lost contact with them during a sample period (Bunck et al. 1995). In defining a time origin, we began our calculation of survival in April when the first study animals were captured, kits had been born, and the trapping season had ended. Because of the small sample size, we were unable to assess quantitatively whether or not we met the assumption that newly tagged animals had the same survival function as previously tagged animals.

Magoun (1985) described wolverine population in the Driftwood area as essentially unharvested. Only 2 of her study animals was harvested, 1 inside and 1 outside the study area, and she documented no natural mortality. Wolverine harvest in the Talkeetna Mountains and the surrounding GMU 13A could be characterized as light to moderate at approximately 1/3 the annual yield or 9% of the estimated population. The maximum harvest of wolverines reported for GMU 13A was 13 in 1984, but the range in subsequent years was 2–7. The estimated density of 4.69 wolverines/1000 km^2 used in the sustainable yield model was slightly lower than other density estimates in Southcentral Alaska that were as high as 5.2 wolverines/1000 km^2 (Golden 1996). Completion of tests to measure the accuracy of the SUPE may result in revised density estimates and, consequently, estimates of sustainable yield.

RECOMMENDATIONS

This study is scheduled to end in June 2000. During the last report period, we will focus on completing the evaluation of the accuracy of the SUPE for wolverines and on comparing the efficacy of the TIPS and SUPE through simulation modeling. We will extend movement analyses to measure home range, using the adaptive kernel and harmonic mean methods (Kie et al. 1996, Hooge and Eichenlaub 1997), which should more accurately portray wolverine movement. We will measure home range size relative to cumulative location, degree of home-range overlap among concomitant wolverines, and spatial and temporal differences in movement patterns. We will prepare papers for publication on results of the SUPE tests and on movements and habitat analyses. We will also prepare papers for publication on (1) a model to estimate wolverine sustainable yield, (2) a comparison of wolverine survival among populations in Alaska, British Columbia, and Idaho through a joint project with other investigators, and (3) on the immobilization of wolverines with Telazol® from a helicopter.

ACKNOWLEDGEMENTS

E. Becker provided assistance with planning for tests of the SUPE technique and with the analysis of wolverine survival data. J. W. Testa provided the software used to estimate sustainable yield and assisted with analysis of some of the model parameters.

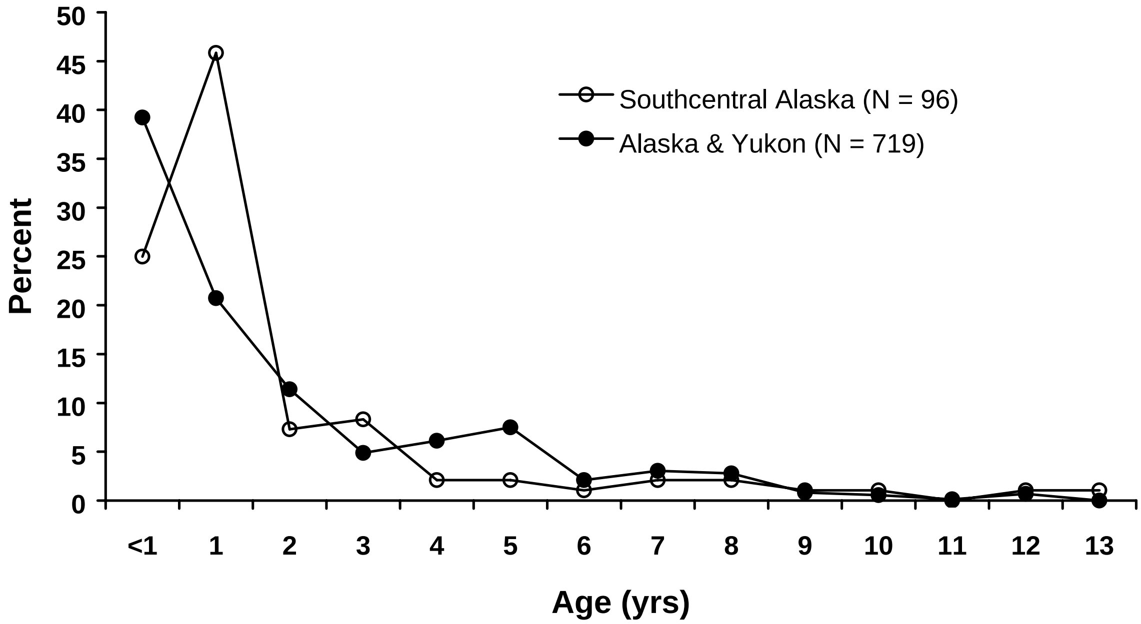

Figure 2.1. Age structures of wolverines harvested in Southcentral Alaska, 1991–1998 (ADF&G unpubl. data), and in Alaska and Yukon, 1962–65 and 1967–68 (Rausch and Pearson 1972). Ages were determined from counts of cementum annuli from carcasses purchased from trappers.

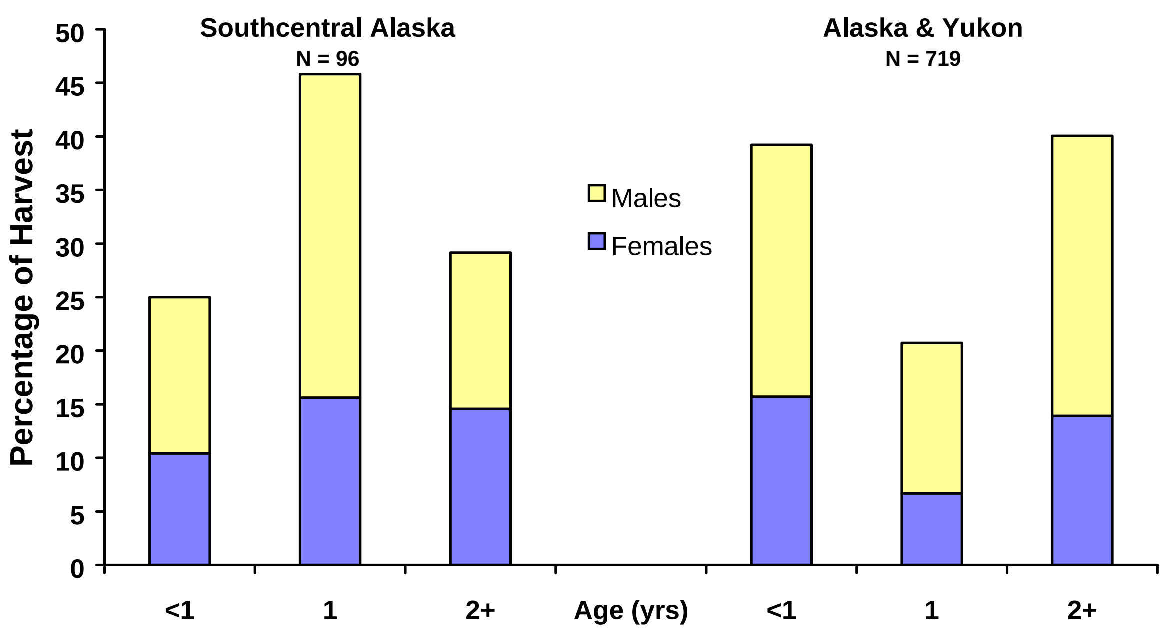

Figure 2.2. Relative proportions of kit (<1 yr old), yearling (1 yr old), and adult (≥ 2 yrs old) wolverines harvested in Southcentral Alaska during 1991–1998 (ADF&G unpubl. data) and in Alaska and Yukon during 1962–65 and 1967–68 (Rausch and Pearson 1972).

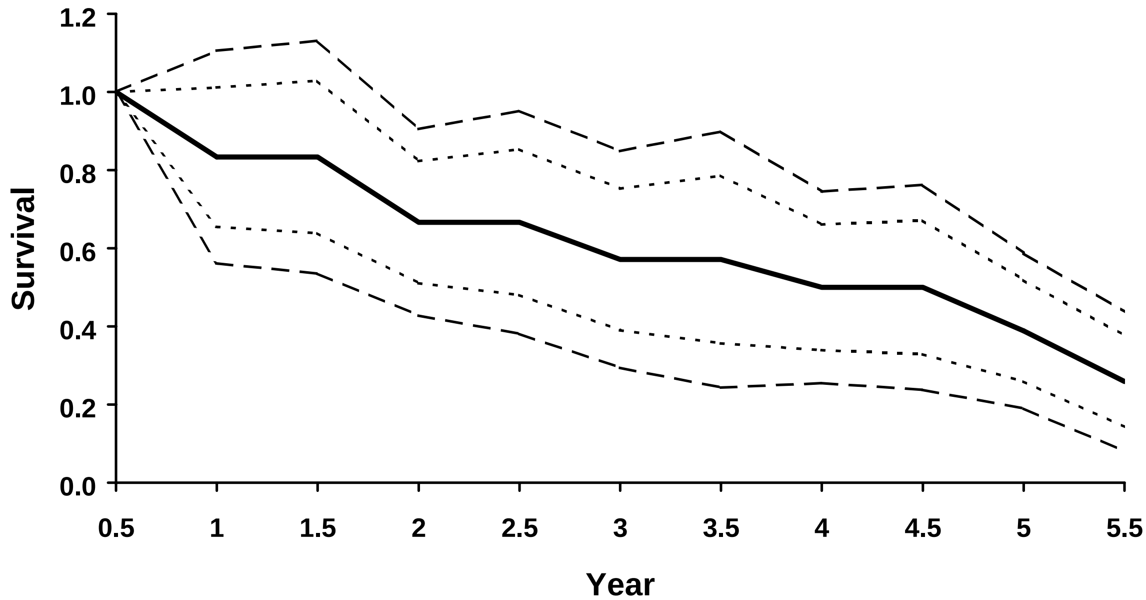

Figure 2.3. Kaplan-Meier survival function (solid line) and 80% (short-dashed line) and 95% (long-dashed line) confidence intervals for radiocollared wolverines (*n* = 22) subject to harvest in the Talkeetna Mountains, Alaska, April 1992–March 1998. The survival function was modified for staggered entry of additional animals (Pollock et al. 1989) and to account for uncertain relocation (Bunck et al. 1995).

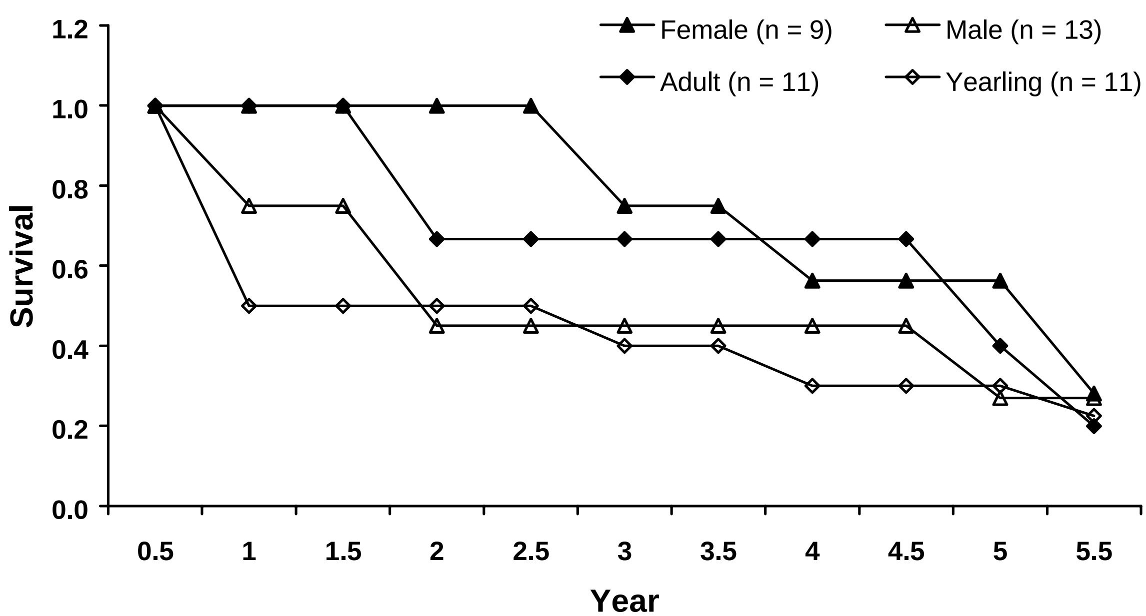

Figure 2.4. Survival functions by sex and age class for radiocollared wolverines in the Talkeetna Mountains, April 1992–March 1998. Survival functions were modified for staggered entry of additional animals (Pollock et al. 1989) and to account for uncertain relocation (Bunck et al. 1995).

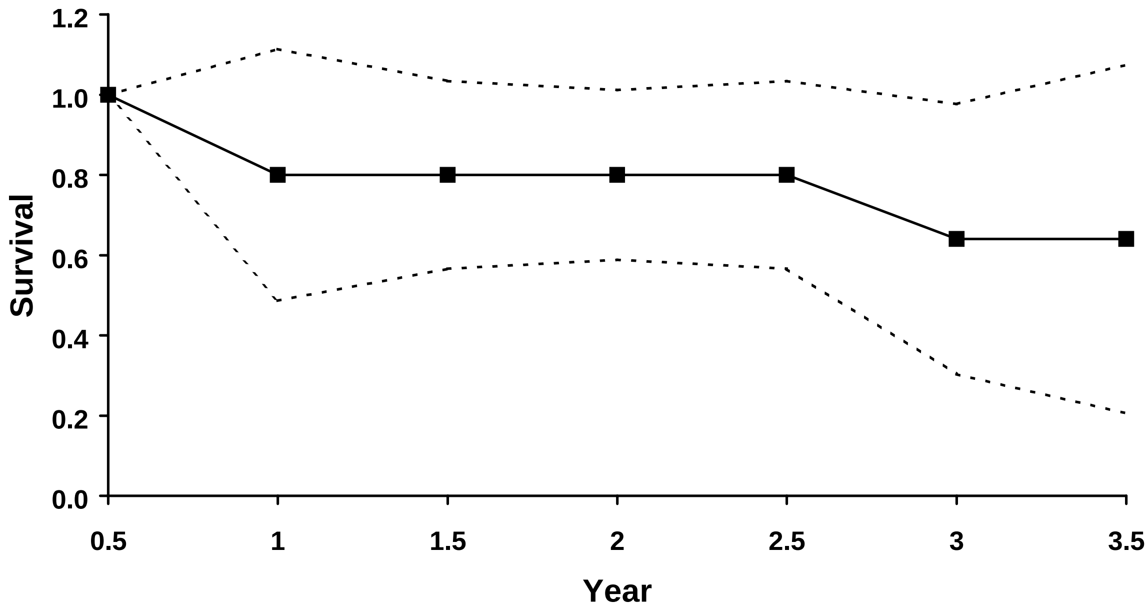

Figure 2.5. Figure 2.3. Kaplan-Meier survival function (solid line) and 95% confidence intervals (short-dashed line) for radiocollared wolverines (n = 20) subject to harvest in the Driftwood area of the western Brooks Range, Alaska, April 1978–March 1982. The survival function was modified for staggered entry of additional animals (Pollock et al. 1989) and to account for uncertain relocation (Bunck et al. 1995).

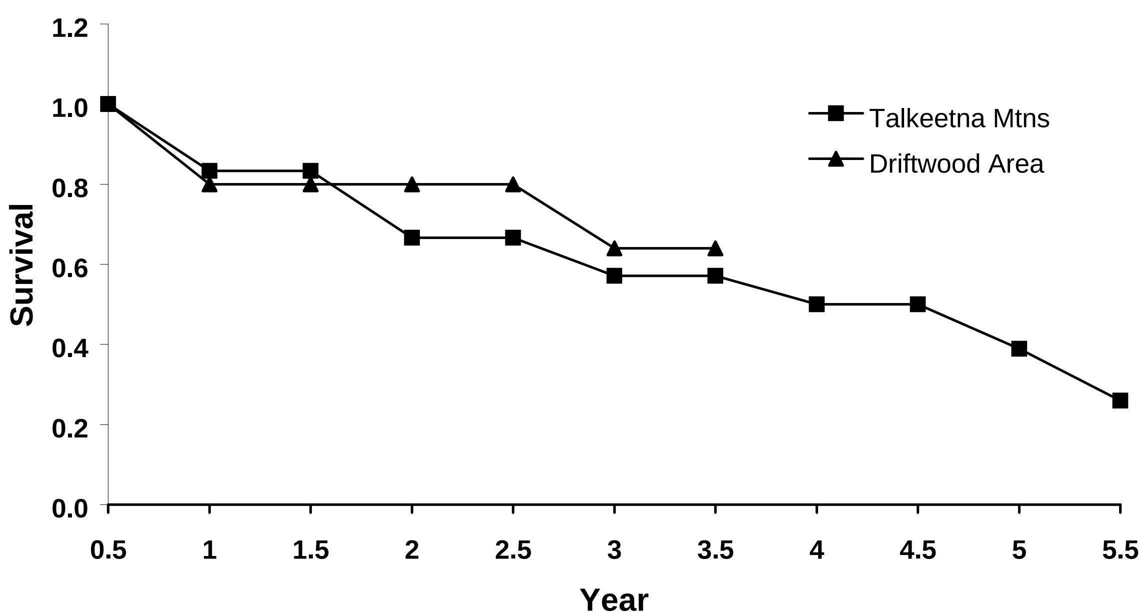

Figure 2.6. Kaplan-Meier survival functions for radiocollared wolverines in the Talkeetna Mountains, Alaska, April 1992–March 1998 (n = 22) and in the western Brooks Range, April 1978–September 1982 (n = 20). The survival functions were modified for staggered entry of additional animals (Pollock et al. 1989) and to account for uncertain relocation (Bunck et al. 1995).

Table 2.1. Kaplan-Meier survival functions for radiocollared wolverines in the Talkeetna Mountains (n = 22), Alaska, April 1992–March 1998 (Golden 1998) and in the Driftwood area of the western Brooks Range (n = 20), April 1978–September 1982 (Magoun 1985). The survival functions were modified for staggered entry of additional animals (Pollock et al. 1989) and to account for uncertain relocation (Bunck et al. 1995).

	Talkeetna Mountains				Driftwood Area			
Year	**At Risk** r_i	**Deaths** d_i	**Survival** $\hat{S}_i$	**95% CI**	**At Risk** r_i	**Deaths** d_i	**Survival** $\hat{S}_i$	**95% CI**
0.5	4	0	1.0000	1.0000–1.0000	8	0	1.0000	1.0000–1.0000
1	6	1	0.8333	0.5611–1.1056	5	1	0.8000	0.4864–1.1136
1.5	5	0	0.8333	0.5351–1.1315	9	0	0.8000	0.5663–1.0337
2	10	2	0.6667	0.4281–0.9052	11	0	0.8000	0.5886–1.0114
2.5	7	0	0.6667	0.3815–0.9518	9	0	0.8000	0.5663–1.0337
3	7	1	0.5714	0.2943–0.8486	5	1	0.6400	0.3034–0.9766
3.5	5	0	0.5714	0.2435–0.8993	3	0	0.6400	0.2055–1.0745
4	8	1	0.5000	0.2550–0.7450				
4.5	7	0	0.5000	0.2381–0.7619				
5	9	2	0.3889	0.1903–0.5875				
5.5	6	2	0.2593	0.0807–0.4378				

Table 2.2. Estimated sustainable yields of female wolverines for an area the size of Game Management Unit 13A, Alaska, 1992–1998, derived from survival estimates from the Talkeetna Mountains and Driftwood area (Table 2) and reproductive data on wolverines in Alaska and Yukon Territory (Rausch and Pearson 1972, Magoun 1985). The model was based on Eberhardt and Siniff (1977) and modified for wolverines by J. W. Testa (personal communication).

	Talkeetna Mountains			**Driftwood Area**		
Variable	**Expected**	**Lower**	**Upper**	**Expected**	**Lower**	**Upper**
Survival from birth to year 1[a]	0.5930	0.3991	0.7983	0.5930	0.3991	0.7983
Annual yearling and adult survival[b]	0.8287	0.7936	0.8637	0.8667	0.7360	0.9973
Age of first parturition[c]	2.75	2.50	3.00	2.75	2.50	3.00
Mean annual birth rate in female offspring per female[cd]	1.31	0.65	2.60	1.31	0.65	2.60
n[e]	27	23	46	27	23	46
λ[f]	1.22	0.97	1.65	1.27	0.91	1.83
Yield[g]	4.91	-0.76	18.12	5.68	-2.36	20.88

[a] Estimated by dividing the proportion of kits/adult female in the harvest by the mean, lower, and upper litter sizes derived from embryo counts in carcasses from wolverines harvested during 1962–1968 (Rausch and Pearson 1972).
[b] Lower and upper values represent the 95% confidence intervals of estimated levels (Fig. 2.1).
[c] Estimated from carcass data from Alaska and Yukon Territory presented by (Rausch and Pearson 1972).
[d] Birth interval was accounted for by multiplying the average litter size of 1.75 female kits by 0.75, 0.50, and 1.0 for expected, lower, and upper levels, respectively. Birth intervals were estimated from (Magoun 1985) and (Hash 1987). A stable age distribution and an even sex ratio at birth were assumed.
[e] Population size of female wolverines extrapolated for an area the size of Game Management Unit 13A (11,500 km^2) from a density estimate of 4.69 wolverines/1000 km^2 in the Talkeetna Mountains study area (4000 km^2) (Becker and Gardner 1992).
[f] Lambda: finite rate of population increase.
[g] Estimated sustainable yield = $n * (\lambda - 1) / \lambda$.

JOB 3 — DISTRIBUTION, TREND, HABITAT USE, AND HARVEST POTENTIAL OF COASTAL RIVER OTTER POPULATIONS

Golden (1996) provided background for this project. During this report period, we focused on (1) sampling scats for DNA microsatellite analysis in Kachemak Bay and Prince William Sound, (2) evaluating latrine sites and random sites for habitat characteristics in Prince William Sound, and (3) analyzing scats of river otter to determine food habits in Kachemak Bay.

OBJECTIVES

3.1 To determine if latrine site use and fecal deposition rates are precise indicators of river otter abundance in coastal areas of Southcentral Alaska.

3.2 To determine which habitat features are most important in defining coastal river otter habitat.

3.3 To evaluate food habits of river otters relative to habitat types and geographic area.

3.4 To estimate sustainable harvest levels of river otter populations in coastal environments of Southcentral Alaska.

STUDY AREAS

The Kachemak Bay study area lies between Kasitsna Bay and Sadie Cove, with the center of activity in Tutka Bay. Habitat features in this part of Kachemak Bay are similar to those described by Bowyer et al. (1995) for western Prince William Sound. Several areas of Kachemak Bay have been developed for housing, which is generally within 100 m of the coastline.

METHODS

Job 3.1. Latrine Site Use and Fecal Deposition Rates by River Otters

We are collaborating with Drs Pamela Groves and Merav Ben-David at the University of Alaska Fairbanks (UAF) to analyze river otter scat for DNA microsatellites (Groves and Ben-David 1997). This procedure extracts DNA from river otter intestinal cells shed within their feces to generate DNA profiles or fingerprints that are specific to individual animals. Microsatellites are hypervariable, noncoding regions of short repeats within DNA that vary in size. They can serve as genetic markers because the regions may be amplified and their sizes compared among individuals with the aid of appropriate markers through polymerase chain reaction products and specific microsatellite primers.

For the DNA analysis, we used 157 scats, all ≤ 3 days old, collected among 23 latrine sites during 5 3-day sample periods in summer 1996 in Kachemak Bay (Golden 1997). We extracted small amounts (1–2 ml) of feces from each sample for analysis through the automated sequencer in the DNA Core Lab at the University of Alaska Fairbanks. Analysis of these data continues. However, because the samples were collected before a protocol was established, it seems they may not be useful for extracting DNA. We plan to collect new samples in summer of 2000.

We sampled river otter scats among 62 latrine sites in Culross Passage, Eshamy Bay, and Herring Bay in Prince William Sound, using procedures described by Golden (1997). No analyses were conducted during this report period.

Job 3.2. Habitat Selection and Movements of River Otters

We assessed the habitat of 32 latrine sites among Naked Island, Peak Island, Storey Island, and Culross Passage in Prince William Sound, using procedures described by Golden (1998). No analyses were conducted during this report period.

Job 3.3. Food Habits of River Otters Among Habitat Types

For diet analysis, we used the remaining portions of the 157 river otter scats from Kachemak Bay used in the DNA microsatellite analysis. We sent the scats to the Marine Mammal Lab at the University of British Columbia for cleaning through an elutriation process. The cleaned scats were then sent to Pacific Identifications in Victoria, British Columbia for identification of food items (Golden 1997). Composition and sizes of diet items were summarized.

Job 3.4. River Otter Population Model

This job was not addressed during this reporting period; we plan to start this job in 2001.

RESULTS AND DISCUSSION

Job 3.1. Latrine Site Use and Fecal Deposition Rates by River Otters

The DNA analysis of the river otter scats from Kachemak Bay is underway, and we expect it to be completed by April 2000. We will use the results to attempt to estimate river otter density and use of latrine sites by individual animals. We will follow the procedure described by Groves and Ben-David (1997) to estimate river otter density using the identification of individuals from DNA microsatellites to conduct a mark-resighting analysis of population density. They used the initial collection of scats at the latrine sites as the marking occasion. A resighting occasion was the subsequent collection of scats from latrine sites several days after the initial collection. They repeated this process several times to produce capture histories that they will use to estimate population density (M. Ben-David, University of Alaska Fairbanks, personal communication). Their analysis is in progress and is expected to determine specific criteria (e.g., the need for closure) that may be required for accurate estimates. For the Kachemak Bay study, we will attempt to identify individual otters and develop capture histories from scats collected in early summer 1996. However, we expect the results to be preliminary and incomplete because we did not design our scat collection procedures to estimate density. We collected scats that had accumulated over 3-day periods that were separated by 3-week periods to measure scat deposition rates among latrine sites (Golden 1997). We plan to conduct a density estimate in Kachemak Bay in May or June 2000 using procedures prescribed by Groves and Ben-David (1997), pending the outcome of their analyses.

Job 3.3. Food Habits of River Otters Among Habitat Types

Preliminary analysis of diet items in river otter scat collected in Kachemak Bay, Alaska in 1996 indicate river otters preferred larger fish (>15 cm) over smaller fish (<8 cm), based on the number of scats per latrine site in which fish were found and the minimal number of fish found per latrine site (Table 3.1). Probably because of the larger quantity of food in the larger fish, the minimum number of individual fish per scat was inversely related to the other 2 parameters; i.e., individual scats contained fewer big fish. The most prevalent families of fish found in scat for 8-cm fish were salmon, gunnel, flatfish, and stickleback; for 8–15-cm fish they were gunnel, codfish, sand lances, and sculpin; and for >8-cm fish the most prevalent were flatfish, sculpin, salmon, and greenling.

RECOMMENDATIONS

We recommend continuing the Kachemak Bay phase of this project for another year to analyze scat contents, movements, food habits, and habitat data. We will focus further fieldwork on river otters in Prince William Sound in cooperation with 2 University of Alaska Fairbanks studies.

ACKNOWLEDGEMENTS

M. Ben-David, J. Fair, N. Fair, M. Sabrowski, J. Crouse, C. Curgus, and the crews of the vessels *Discovery* and *Alexandra* helped with latrine site surveys, habitat assessments, scat sampling, and logistics in Prince William Sound. J. DeCreft conducted radiotelemetry flights in Prince William Sound.

Table 3.1. Length classes of fish families found in river otter scats among latrine sites in Kachemak Bay, Alaska, 1996.

Length Class	**Family Common Name**	**Scat Counts/ Latrine Site**	**Minimum Number Individual Fish/Site**	**Minimum Number Individual Fish /Scat**
<8 cm	Codfishes	5	5	1.0
	Flatfishes	9	9	1.0
	Gunnels	13	15	1.2
	Poachers	1	1	1.0
	Pricklebacks	3	13	4.3
	Ronquils	2	2	1.0
	Salmons	14	50	3.6
	Sand Lances	4	9	2.3
	Scorpionfishes	1	1	1.0
	Sculpins	5	11	2.2
	Smelts	2	2	1.0
	Snailfishes	1	1	1.0
	Sticklebacks	9	43	4.8
	Totals	**69**	**162**	**2.3**
8–15 cm	Codfishes	24	32	1.3
	Flatfishes	18	25	1.4
	Greenlings	2	2	1.0
	Gunnels	41	83	2.0
	Herrings	1	1	1.0
	Pricklebacks	6	11	1.8
	Ronquils	15	19	1.3
	Salmons	1	1	1.0
	Sand Lances	22	77	3.5
	Scorpionfishes	1	1	1.0
	Sculpins	20	24	1.2
	Smelts	1	1	1.0
	Sticklebacks	6	17	2.8
	Totals	**158**	**294**	**1.9**
>15 cm	Codfishes	17	19	1.1
	Flatfishes	83	109	1.3
	Greenlings	24	26	1.1
	Gunnels	18	30	1.7
	Gunnels/Pricklebacks	1	1	1.0
	Herrings	3	3	1.0
	Pricklebacks	13	15	1.2
	Ronquils	8	11	1.4
	Salmons	27	28	1.0
	Sand Lances	3	3	1.0
	Scorpionfishes	1	1	1.0
	Sculpins	44	51	1.2
	Unknown Fishes	1	1	1.0
	Wolffishes	2	2	1.0
	Totals	**245**	**300**	**1.2**

JOB 4 — APPLYING THE LYNX TRACKING HARVEST STRATEGY THROUGH RULE-BASED MODELING

I updated the user guide to installing and running the model, LynxTrak, and distributed a runtime version of the model to potential users on the web site of the Alaska Department of Fish and Game.

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